TITLE OF THE INVENTION

REFRIGERATOR, FREEZER, STORAGE CONTAINER, AND COLD STORAGE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a refrigerator, freezer, storage container, and cold storage, and specifically, to a refrigerator, freezer, storage container, and cold storage which preserve the freshness of foods using the vacuum technology.

Background Art

Conventional refrigerator-freezers have a primary interest in cooling the inside and it is hard to say that sufficient measures have not always been taken to maintain freshness and quality of foods to be cooled, refrigerated, or frozen. For example, vegetables, fruits, and other foodstuff breathe on their surfaces, and by the breathing, they age and lose freshness, and eventually, wither or wilt. However, when they are stored at low temperature, the breathing rate lowers, for example, when the ambient temperature lowers from 15°C to 0°C, the breathing rate lowers to 1/3 to 1/5, and the freshness can be maintained for a long time. However, fruit vegetables such as cucumbers and tomatoes are okay to be refrigerated as they are but in the case of leaf vegetables such as cabbages and Chinese cabbages, air contained between leaves play a role of heat insulator, causing a problem that it takes about 10 hours to cool the inside when

they are refrigerated as they are. However, if temperature is lowered to below 0°C and they are rapidly cooled, ice may adhere to the leaf surfaces because of the effect of ambient moisture taken in when a door is opened or closed or the cell fluid inside the leaf cell is frozen, and freshness is conversely lost excessively. In addition, even in the case of foodstuff such as thinly sliced raw fish (sashimi) and eels broiled without any seasoning, if ice adheres to the surface, the cell liquid inside the cell is frozen, or the foodstuff is oxidized, the surface is discolored and the foodstuff looks bad and lose flavor.

Hitherto, this kind of problem was met by varying the refrigerator inside temperature in accord with the foodstuff to be refrigerated/frozen or by adjusting temperature stepwise. However, it is troublesome and increases cost to subtly adjust temperature for each foodstuff to be stored. In addition, temperature control alone cannot completely prevent ice accretion to the food surface or freeze of cell liquid.

Furthermore, methods, etc. to store for a long time with food freshness maintained by generating the electric field by static electricity in the refrigerator have been reported. The electric field by static electricity acts on the moisture of the foodstuff in the refrigerator and fractionates water clusters. By this, freshness of meats and fishery products can be maintained and vegetables and fruits do not have to lose freshness over a long period of time. However, this method has several problems, including those that it is difficult to maintain the stable electric field because of moisture content, dew condensation,

ice formation, etc. inside the refrigerator, and high-voltage power supply is required.

On the other hand, it is known that some bio-ceramics including tourmaline, zirconium, and others generate negative ions semi-permanently. In addition, it is also known that water clusters are fractionated by negative ions.

Disclosure of the Invention

The present invention provides a refrigerator-freezer which has one or a plurality of storages and a cooling means for cooling the storages, comprising hermetically sealed containers installed inside the storages to store foods to be refrigerated/frozen, an exhaust means for individually discharge exhaust of the hermetically sealed containers, and a switching means for turning ON/OFF the exhaust means.

By this, it is possible to individually exhaust hermetically sealed containers in storages and vegetables, fruits, and other foodstuff can be stored with the freshness preserved more effectively and for a longer time than simple refrigeration or freezing.

The present invention is characterized in that in the refrigerator-freezer, a vacuum breaking means for breaking the vacuum condition after discharging exhaust by the exhaust means is provided for the hermetically sealed containers.

By this, it is possible to easily open and close the hermetically sealed containers under vacuum and in the refrigerated state.

The present invention is characterized in that the refrigerator-freezer has an open-close detection means for detecting open-close of container door section provided to the hermetically sealed containers.

Because by this, it is possible to discharge exhaust after making sure the container door section is open or closed, there is no need to carry out unnecessary exhaust discharging.

The present invention is characterized in that the refrigerator-freezer further comprises a temperature detection means for detecting temperature inside the hermetically sealed container, wherein the exhaust means discharges exhaust after the temperature detection means detects that the temperature inside the hermetically sealed container lowers to the specified value.

By this, in the event that the temperature inside the hermetically sealed container is high, temperature inside the container can be lowered by convection of air inside and can be efficiently cooled.

The present invention is characterized in that a bio-ceramic element which has bioactivity for generating negative ions is located inside the hermetically sealed container.

By this, it is possible to prevent the foodstuff inside the hermetically sealed container from being oxidized and the flavor from being impaired by the effects of negative ions which the bio-ceramic generates. Furthermore, effects of suppressing odor generated by the foodstuff inside the hermetically sealed container are produced, too. Because generation of negative ions

of the bio-ceramic is semi-permanent, the effects continue once it is installed.

The present invention also provides a refrigerator-freezer which has a plurality of storages and a cooling means for cooling the storages, comprising hermetically sealed containers installed inside the storages to store foods to be refrigerated and frozen, connection ends mounted to the storages, exhaust ducts that can be connected to the hermetically sealed containers by the connection ends, a common exhaust means for discharging exhaust of the hermetically sealed containers connected to the exhaust duct via the connection ends by discharging exhaust inside the exhaust duct, and an operating device for operating connections between the hermetically sealed containers and the exhaust duct.

Because by this, the refrigerator can keep the hermetically sealed container in the vacuum condition by the common exhaust means and can prevent the food stuff from coming in contact with air, it is possible to achieve a refrigerator-freezer which can maintain the foodstuff freshness for a long time by preventing oxidation of the foodstuff and ice formation on the foodstuff surface.

The present invention is also characterized in that in the refrigerator-freezer, the operating means does not open the connection between the hermetically sealed containers and the exhaust duct when the hermetically sealed containers are not connected to the connection ends of the exhaust duct.

Because by this, exhaust is not discharged from the exhaust

duct unless it is checked that the hermetically sealed container is connected to the exhaust duct, there is no fear of discharging unnecessary exhaust.

The present invention is also characterized in that the refrigerator-freezer further comprises a temperature detection means for detecting the temperature inside the hermetically sealed container wherein the operating means opens the connection between the hermetically sealed containers and the exhaust duct after detecting that the temperature inside the hermetically sealed container lowers to the specified value.

By this, in the event that the temperature inside the hermetically sealed container is high, temperature inside the container can be lowered by convection of air inside and can be efficiently cooled.

The present invention is also characterized in that the refrigerator-freezer has a vacuum breaking means for breaking the vacuum condition after exhaust by the exhaust means is mounted to the hermetically sealed containers.

By this, it is possible to easily open and close the hermetically sealed container under vacuum and in the refrigerated condition.

The present invention is also characterized in that the refrigerator-freezer has a bio-ceramic element which has bioactivity to generate negative ions is located inside the hermetically sealed containers.

By this, it is possible to prevent the foodstuff inside the hermetically sealed container from being oxidized and the flavor

from being impaired by the effects of negative ions which the bio-ceramic generates. Furthermore, effects of suppressing odor generated by the foodstuff inside the hermetically sealed container are produced, too. Because generation of negative ions of the bio-ceramic is semi-permanent, the effects continue once it is installed.

The present invention also provides a refrigerator-freezer which has one or a plurality of storages and a cooling means for cooling the storages, which are formed into a hermetically sealed construction, and is equipped with an exhaust means for discharging exhaust of the storages of the hermetically sealed construction.

By this, it is possible to achieve a refrigerator-freezer which can maintain the foodstuff freshness for a long time by preventing oxidation of the foodstuff and ice formation on the foodstuff surface in the vacuum condition by hermetically sealing the storage and preventing the foodstuff from coming in contact with air.

The present invention is also characterized in that the refrigerator-freezer has a vacuum breaking means for breaking the vacuum condition after the exhaust means discharges exhaust equipped to the storage.

By this, it is possible to easily open and close the storage under vacuum and in the refrigerated condition.

The present invention is also characterized in that the refrigerator-freezer has the exhaust means which waits until the temperature inside the storages lowers to the specified

temperature and carries out the exhaust operation.

By this, in the event that the temperature inside the storage is high, temperature inside the storage can be lowered by convection of air inside and can be efficiently cooled.

The present invention is also characterized in that the refrigerator-freezer has an open-close detection means for detecting the open-close of the storage door, which is installed to the storage.

Because by this, exhaust can be discharged by making sure the storage door is open or closed, there is no fear of discharging unnecessary exhaust.

The present invention is also characterized in that the refrigerator-freezer has the cooling means which has a plurality of heat exchangers inside the storage.

By this, it is possible to effectively cool even when exhaust takes place and at the same time to keep the humidity of the storage.

The present invention is characterized in that the refrigerator-freezer has a bio-ceramic element which has bioactivity to generate negative ions located inside the storage.

By this, it is possible to prevent the foodstuff inside the storage from being oxidized and the flavor from being impaired by the effects of negative ions which the bio-ceramic generates. Furthermore, effects of suppressing odor generated by the foodstuff inside the storage are produced, too. Because generation of negative ions of the bio-ceramic is semi-permanent, the effects continue once it is installed.

The present invention provides a storage container used for storing reserves in refrigerator-freezer which comprises a hermetically sealing means for hermetically sealing the storage containers, an exhaust means for individually discharging exhaust of the storage containers, and a switching means for turning ON/OFF the exhaust means.

Because by this, the cold storage can keep the storage container hermetically sealed in the vacuum condition and can prevent the food stuff from coming in contact with air, it is possible to achieve a cold storage which can maintain the foodstuff freshness for a long time by preventing oxidation of the foodstuff and ice formation on the foodstuff surface.

The present invention is characterized in that the storage container has a vacuum breaking means for breaking the vacuum condition after exhaust is discharged by the exhaust means equipped to the storage containers.

By this, it is possible to easily open and close the storage container under vacuum and in the refrigerated condition.

The present invention is characterized in that the storage container has a bio-ceramic element which has bioactivity to generate negative ions located inside the storage containers.

By this, it is possible to prevent the foodstuff inside the storage container from being oxidized and the flavor from being impaired by the effects of negative ions which the bio-ceramic generates. Furthermore, effects of suppressing odor generated by the foodstuff inside the container are produced, too. Because generation of negative ions of the bio-ceramic is semi-permanent,

the effects continue once it is installed.

The present invention provides a cold storage which has a freezer compartment that can refrigerate and store preserves in the warehouse which comprises a hermetically sealing means for hermetically sealing the freezer compartment, an exhaust means for individually discharging exhaust of the freezer compartment, and a switching means for turning ON/OFF the exhaust means.

Because by this, the cold storage can keep the freezer in the vacuum condition and can prevent the food stuff from coming in contact with air, it is possible to achieve a cold storage which can maintain the foodstuff freshness for a long time by preventing oxidation of the foodstuff and ice formation on the foodstuff surface.

The present invention is also characterized in that the cold storage has a vacuum breaking means for breaking the vacuum condition after exhaust is discharged by the exhaust means equipped to the freezer compartment.

By this, it is possible to easily open and close the freezer compartment under vacuum and in the refrigerated condition.

The present invention is also characterized in that the cold storage has a bio-ceramic element which has bioactivity to generate negative ions located inside the freezer compartment.

By this, it is possible to prevent the foodstuff inside the freezer compartment from being oxidized and the flavor from being impaired by the effects of negative ions which the bio-ceramic generates. Furthermore, effects of suppressing odor generated by the foodstuff inside the freezer compartment are produced,

too. Because generation of negative ions of the bio-ceramic is semi-permanent, the effects continue once it is installed.

The present invention is also characterized in that the storage container has a temperature sensor for detecting the existence of humans or living organisms by temperature mounted inside the freezer compartment.

By this, it is possible to avoid danger of humans and living organisms from being confined in the freezer compartment.

Brief Description of the Drawings

Fig. 1 is a cross sectional view of one embodiment of the industrial refrigerator according to the present invention;

Fig. 2 is a cross sectional view of the other embodiment of the industrial refrigerator-freezer according to the present invention;

Fig. 3 is a cross sectional view of another embodiment of the industrial refrigerator-freezer according to the present invention;

Fig. 4; and

Fig. 5 is a cross-sectional view of the other embodiment of the household refrigerator-freezer according to the present invention.

Best Mode for Carrying Out the Invention

Referring now to the drawings, embodiments of the present invention will be described in detail hereinafter.

Fig. 1 is a cross sectional view of one embodiment of the

industrial refrigerator-freezer 10 according to the present invention.

In Fig. 1, reference numeral 11 denotes a hermetically sealed container, 12 a housing covering, 13 an heat insulator, 14 a door, 15 an operation panel, 16 a heat exchanger, 17 a cold air circulating fan, 18 a compressor, 19 an exhaust pump, 20 an exhaust duct, 21 shelves catch, 22 shelf board, 23, packing, and 24 vacuum breaker handle.

In keeping with Fig. 1, operation of the industrial refrigerator-freezer 10 of the present invention will be described.

The present industrial refrigerator-freezer 10 is formed into a box by the housing covering 12 comprising metal sheets, etc. and the heat insulator 13 for cold insulation to back the housing covering. The compressor 18 is driven by a motor not illustrated and when the compressor 18 is operated, steam of a refrigerant which is evaporated by the heat exchanger 16 and becomes low temperature and low pressure is sucked into the compressor 18 and compressed, and becomes steam at temperature considerably higher than room temperature. This steam is allowed to pass a condenser not illustrated located outside the industrial refrigerator-freezer10 and to discharge heat. Then, the steam is liquefied while it passes the condenser. This liquefied refrigerant is allowed to pass a capillary tube not illustrated and directed to the heat exchanger 16. In such event, the refrigerant pressure is lowered by the fluid resistance of the capillary tube, the refrigerant expands to vaporize, and deprives

itself from heat by the vaporization heat at the heat exchanger 16 inside the industrial refrigerator-freezer 10 as well as deprives the surrounding from heat to lower its temperature, and thereby lowers the temperature inside the refrigerator-freezer. This is same as the operation inside a regular refrigerator.

The storage inside of the industrial refrigerator-freezer 10 is formed into the hermetically sealed container 11 and the door section is built integral with the door 14 of the refrigerator 10. To the inside of this hermetically sealed container 11, the shelf board 22 supported by the shelves catch 21 is mounted and foodstuff can be placed. The shelf board 22 is of a mesh or grating construction to achieve vertical permeability and is intended not to serve as resistance to air flow during exhaust discharge. When the foodstuff is refrigerated, the foodstuff is stored by being placed on the shelf board 22 of the hermetically sealed container 11. When the door 14 is closed after storing the foodstuff, the packing 23 equipped on the inner side of the door 14 hermetically seals the hermetically sealed container 11. Pressing an exhaust switch on the operation panel 15 equipped on the door 14 in advance can detect the complete closure of the door 14 and at the same time causes the exhaust pump 19 to operate to discharge air inside the hermetically sealed container 11 via the exhaust duct 20. A switch of the operation panel 15 equipped on the door 14 may be pressed after storing the foodstuff to make the exhaust pump 19 operating. By this, the inside of the hermetically sealed container 11 is brought to the negative atmosphere, vacuum state. When the specified negative pressure

state is achieved, the exhaust pump 19 automatically stops. The open-close state of the door 14 can be detected by a detection switch or others mounted on the door 14 side or to the door section of the hermetically sealed container 11.

Because refrigerating the foodstuff in the evacuated hermetically sealed container 11 can prevent oxidation of foodstuff, the freshness of foodstuff can be preserved for a long time and discoloration of foodstuff can be prevented. In particular, when leaf vegetables are stored, since air between leaves is discharged and the moisture content adhering to the leaf surface vaporizes to deprive them from vaporization heat, the vegetables can be cooled quickly to the inside and at the same time the moisture content does not adhere to the leaf surface in the form of ice, and the freshness can be preserved for a long time.

Furthermore, affixing a bio-ceramic element to the wall inside the hermetically sealed container 11 can preserve the freshness of foodstuff much longer by the effects of negative ions generated by the bio-ceramic, and the foodstuff can stay fresh for a long time. The effect of this bio-ceramic can be semi-permanently maintained.

Now, the hermetically sealed container 11 from which air is once discharged cannot be opened easily because of the atmospheric pressure. To solve this problem, in the present embodiment, the vacuum breaker handle 24 is equipped, and when the door 14 is opened, this handle 24 is operated and the door is opened after breaking the vacuum first. Any type and form of a vacuum breaker

handle 24 may be used as long as it is of the type which opens the vent passage by operating the handle and closes the vent passage by returning.

In addition, there is a problem in that convection does not take place when air inside the container is lost and cooling is not efficiently carried out at the time of exhaust discharge and cooling of the hermetically sealed container 11. On the other hand, discharging exhaust after air inside the container is cooled is a waste of thermal capacity used for cooling the exhausted air. In view of this, it is efficient to promote convention in the stage of comparatively high temperature, and discharge exhaust after the air lowers to a specified temperature. Consequently, in the present invention, a means for detecting the temperature of hermetically sealed container 11 is provided and exhaust is discharged when a specified temperature is achieved. Or, contrivances can be made to prevent the hermetically container from achieving complete vacuum after exhausting.

Fig. 2 is a cross-sectional view showing the other embodiment of an industrial refrigerator-freezer 10 according to the present invention. In Fig. 2, reference numerals 11a and 11b denote a hermetically sealed container, 12 housing covering, 13 a heat insulator, 14 a door, 15 an operation panel, 16 a heat exchanger, 17 a cold air circulating fan, 18 a compressor, 19 an exhaust pump, 20 an exhaust duct, 21a and 21b a shelves catch, 22a and 22b a shelf board, 23a and 23b packing, 24a and 24b a vacuum breaker handle, 25a and 25b a container door, and 26a and 26b an operating device. For convenience, like reference characters designate

like or corresponding parts in Fig. 1.

What the present embodiment differs from that shown in Fig. 1 is that a plurality of hermetically sealed containers 11a, 11b are equipped inside the refrigerator-freezer. These hermetically sealed containers 11a, 11b are connected independently to the exhaust duct 20, respectively, and between hermetically sealed containers 11a, 11b and the exhaust duct 20, operating devices 26a, 26b are equipped. To hermetically sealed containers 11a, 11b, container doors 25a, 25b are equipped, respectively and can be opened and closed independently. To container doors 25a, 25b, vacuum breaker handles 24a, 25b are equipped, respectively, and can separately break vacuum of hermetically sealed containers 11a, 11b, respectively.

When the foodstuff is refrigerated, the foodstuff is housed in these hermetically sealed containers 11a, 11b, container doors 25a, 25b are closed, and hermetically containers 11a, 11b to be exhausted are designated from the operation panel 15 mounted to the door 14, and exhaustion is directed. By this, the exhaust pump 19 begins exhaust action and at the same time, the operating device 26a or 26b that connects the exhaust duct 20 to the directed hermetically sealed container 11a or 11b is opened and air in the designated hermetically sealed container 11a or 11b is discharged. By this configuration, hermetically sealed containers 11 with still smaller capacity are independently controlled, respectively, to refrigerate the foodstuff under vacuum.

It is possible to reserve the freshness of foodstuff for still

longer time by the effects of negative ions by equipping a bio-ceramic element to the inside of these hermetically sealed containers 11, too.

Fig. 3 is a cross-sectional view of another embodiment of industrial refrigerator-freezer 10 according to the present invention. In Fig. 3, reference numeral 12 denote a housing covering, 13 a heat insulator, 14 a door, 16 a heat exchanger, 17 cold air circulating fan, 18 a compressor, 19 an exhaust pump, 20 an exhaust duct, 23 packing, 24 a vacuum breaker handle, and 27 a sealed compartment. For convenience, like reference characters designate like or corresponding parts in Fig. 1 and Fig. 2.

What the present embodiment differs from those shown in Fig. 1 and Fig. 2 is that the storage is replaced by a sealed compartment 27. The sealed compartment 27 is constructed to be sealed by door 14, and to the door 14, a vacuum breaker handle 24 is equipped. To the periphery of the hermetically sealed compartment 27 of the door 14 and to the side with which the door of the hermetically sealed compartment 27 comes in contact, packing 23 is mounted to prevent air leakage.

When the foodstuff is refrigerated, housing the foodstuff in these hermetically sealed compartments 27 and closing the door 14 causes the exhaust pump 19 to automatically start exhaust operation and the hermetically sealed compartment 27 is exhausted. In addition, it is possible to start discharging exhaust after the temperature inside the hermetically sealed compartment 27 of the storage lowers to a specified temperature. By this, in

the stage where the inside temperature is comparatively high, it is possible to cool he inside by convection of air inside and the cooling effects can be improved. Furthermore, it is possible to equip a plurality of heat exchanger 16 in the sealed compartment 27 to maintain cooling effects even after exhausting. By this kind of configuration, a simplified type industrial refrigerator-freezer 10 with smaller capacity is achieved and the foodstuff can be refrigerated in vacuum. By the way, the exhaust pump 19 may be located outside the housing and externally mounted. To this sealed compartment 27, a bio-ceramic element may be mounted inside as is the case of the above-mentioned examples, thereby preserving the foodstuff freshness much longer by the negative ion effects.

In the foregoing description, industrial refrigerator-freezer according to the present invention has been described, but the same hermetically sealing and exhaust configuration can be applied to storage containers housed in cold storages and freezer compartments of cold storages. That is, in the storage container, this can be achieved by the construction same as the hermetically sealed containers shown in Fig. 2 with an exhaust device equipped to each container, and freezer compartments of cold storages can be achieved by increasing the size with the construction same as that of industrial refrigerator of Fig. 3 adopted. Needless to say, the foodstuff freshness can be preserved still longer by negative ion effects by mounting bio-ceramic elements to the inside of these storage containers and freezer compartments. In addition, to prevent humans and

creatures such as dogs and cats from being left inside the refrigerator storage, temperature sensors that detect the existence of creatures by the bodily temperature are mounted and refrigeration function and evacuating function may be stopped in the event temperature sensors detect the bodily temperature.

Fig. 4 is a cross-sectional view showing a configuration of one embodiment of a household refrigerator 10 according to the present invention. In Fig. 4, reference numeral 11-1 through 11-5 denote a hermetically sealed container according to the present invention, 12 a housing covering, 13 a heat insulator, 14 a door, 14-1 a storage door, 14-2 vegetable crisper door, 14-3 and 14-4 freezer compartment doors. Furthermore, reference numeral 16-1 a heat exchanger for storage, 16-2 a heat exchanger of freezer compartment, 17-1 a cold air circulating fan for storage and 17-2 a cold air circulating fan for freezer compartment, 18 a compressor, 19 an exhaust pump, 20 an exhaust duct, 28 an operating device, 29 refrigerator lighting lamp, 30 a storage, 31 a vegetable crisper, 32 a freezer compartment A, and 33 a freezer compartment B. For convenience, like reference characters designate like or corresponding parts in Fig. 1, Fig. 2, and Fig. 3.

In keeping with Fig. 4, operation of the household refrigerator 10 of the present invention will be described. The compressor 18 is driven by a motor not illustrated. When the compressor 18 is operated, steam of a low-temperature low-pressure refrigerant which is evaporated by the storage heat exchangers 16-1 and freezer compartment heat exchanger 16-2 is

sucked in the compressor 18 and compressed, and acquires temperature considerably higher than room temperature. This steam is allowed to pass a condenser not illustrated located outside the refrigerator 10 and to discharge heat. Then, the steam is liquefied while it passes the condenser. This liquefied refrigerant is allowed to pass a capillary tube not illustrated and directed to the storage heat exchanger 16-1 and freezer compartment heat exchanger 16-2. In such event, the refrigerant pressure is lowered by the fluid resistance of the capillary tube, the refrigerant expands to vaporize, and deprives itself from heat by the vaporization heat at the storage heat exchanger 16-1 and freezer compartment heat exchanger 16-2 inside the refrigerator 10 as well as deprives the surrounding from heat to lower its temperature, and thereby lowers the temperature inside the refrigerator. This is same as the operation inside a regular refrigerator.

To the storage 30, vegetable crisper 31, freezer compartment A 32 and freezer compartment B 33, hermetically sealed containers 11-1 through 11-5 are removably mounted. The hermetically sealed containers 11-1 through 11-5 are individually connected to exhaust duct 20, respectively, and between hermetically sealed containers 11-1 through 11-5 and exhaust duct 20, the operating device 28 is installed. When this operating device 28 is opened, air inside the container is discharged by the action of exhaust pump 19, the inside of the hermetically sealed containers 11-1 through 11-5 is depressurized and achieves the vacuum condition below atmospheric pressure.

When the foodstuff is refrigerated, the foodstuff is housed in the hermetically sealed containers 11-1 through 11-5, and after the temperature inside the hermetically sealed containers 11-1 through 11-5 is lowered to a certain extent, air inside the hermetically sealed containers 11-1 through 11-5 is discharged. When temperature inside the hermetically sealed containers 11-1 through 11-5 is lowered, while temperature is comparatively high, it is effective to cool by the use of convection of air inside. Consequently, in this stage, air inside the hermetically sealed containers 11-1 through 11-5 is not discharged but the temperature inside the hermetically sealed containers 11-1 through 11-5 is monitored and the air is discharged when the air temperature lowers to a certain extent. Or the covers of the hermetically sealed containers 11-1 through 11-5 are closed and air is discharged with a specified time provided after the exhaust is directed.

Because refrigerating the foodstuff in the evacuated hermetically sealed container 11 in this way can prevent oxidation of foodstuff, the freshness of foodstuff can be preserved for a long time and discoloration of foodstuff can be prevented. In addition, when leaf vegetables are preserved in the hermetically sealed container 11-3 of the vegetable crisper 31, since air between leaves is discharged and the moisture content adhering to the leaf surface is likely to vaporize and deprives them from vaporization heat, the vegetables can be cooled quickly to the inside, and are difficult to lose the freshness. In addition, when pieces of ice made in hermetically sealed containers 11-4,

11-5 of the freezer compartment A 32 and freezer compartment B 33 or frozen foodstuff are preserved, it is possible to prevent ice pieces and frozen foodstuff from being stuck each other due to moisture in air, and they can be handled easily.

By the way, affixing a bio-ceramic element to the wall inside the hermetically sealed containers 11-1 through 11-5 as is the case of above-mentioned examples can preserve the freshness of foodstuff much longer by the effects of negative ions.

The operating device 28 can be opened and closed by a panel switch not illustrated, which is mounted, for example, to the surface of the refrigerator proper 10. In such event, by allowing the operating device 28 to open only when it recognizes that hermetically sealed containers 11-1 through 11-5 are connected to the corresponding connection ends of the exhaust duct 20 and not to open when they are not connected, the exhaust pump 19 can be prevented from making unnecessary exhaust action.

Now, because the hermetically sealed containers 11-1 through 11-5 from which air is once discharged cannot be opened easily because of the atmospheric pressure, a handle not illustrated for breaking vacuum is mounted to each of hermetically sealed containers 11-1 through 11-5 and when the exhausted hermetically sealed containers 11-1 through 11-5 are opened, the vacuum breaker handle is used to break vacuum before opening the containers.

Now, for the refrigerator 10, a motor is necessary to operate the compressor 18. This motor for compressor is not continuously operated but intermittently operated only when the refrigerator inside must be cooled. Consequently, the motor for compressor

can be used also as the motor for driving the exhaust pump 19, and by this, the device can be fabricated less expensively and in a smaller size.

In the foregoing description, it was described that the hermetically sealed containers 11-1 through 11-5 are connected to the exhaust duct 20 and exhausted by the same exhaust pump 19. However, it is also possible to provide a simplified exhaust means to each of the hermetically sealed containers 11-1 through 11-5 and to evacuate air from the hermetically sealed containers 11-1 through 11-5. Fig. 5 shows a cross-sectional view of another embodiment of the household refrigerator 10 with such configuration according to the present invention.

In Fig. 5, for convenience sake, like reference characters designate like or corresponding parts in Fig. 4.

What the present embodiment differs from that shown in Fig. 4 is that the exhaust system 35-1 through 35-5 is installed to each of hermetically sealed containers 11-1 through 11-5, respectively. The exhaust system 35-1 through 35-5 comprises a small exhaust pump, blower, and others. The power supply of exhaust systems 35-1 through 35-5 may be taken, for example, from outlets provided inside the refrigerator and exhaust systems 35-1 through 35-5 may be turned on/off by the switch mounted to the cover portion of the exhaust system 35-1 through 35-5.

In the present embodiment, too, air inside the hermetically sealed containers 11-1 through 11-5 may be discharged when the air temperature inside the hermetically sealed containers 11-1 through 11-5 lowers to a certain degree or with the cover of the

hermetically sealed containers 11-1 through 11-5 closed and with a specified time provided after the exhaust is directed. In addition, in such event, too, a bio-ceramic element may be mounted inside the hermetically sealed containers 11-1 through 11-5 as is the case of the above-mentioned examples, thereby preserving the foodstuff freshness much longer by the negative ion effects.

Although the household refrigerator-freezer according to the present invention has been described in keeping with the embodiment, it is understood that the present invention may be embodied in several forms without departing from the spirit of essential characteristics thereof. For example, in the embodiments of Fig. 4 and Fig. 5, one each of heat exchanger is mounted to each of the freezer compartment and the storage, respectively, but needless to say, one heat exchanger may be used and the refrigerator is of a type to separate the freezer compartment and the storage in accord with the cold air circulating position. Furthermore, though no detailed description has been made, various changes and modifications may be made in the size and shape of the hermetically sealed container, mounting position of the exhaust duct or exhaust system, etc. without departing from the spirit and scope thereof.